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Modelling the Economic Impact of Brexit on the Welsh Economy

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MODELLING THE ECONOMIC IMPACT OF BREXIT ON THE WELSH ECONOMY

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Abstract

We provide an impact assessment of Brexit using a dynamic Computable General Equilibrium model. Three scenarios are considered: (a) no deal with the EU i.e. revert to WTO scenario in March 2019; (b) agree an extension to Article 50 between the UK and EU a status quo scenario; (c) negotiate a comprehensive EU-Canada style trade agreement between the EU and UK. We did not examine the option of EEA membership as this would cut across the UK Government's red lines as announced in the Prime Minister's Lancaster House speech. Our results show that the impact on the Welsh economy will be felt primarily through reductions in GDP, GDP per capita, trade, investment and employment. In sum, Wales loses under all scenarios, but with smaller losses under the status quo scenario. Continuation of an extended status quo for a limited period of time is the best policy option. A comprehensive EU-Canada style trade agreement is the next best option. Reverting to trading on WTO terms should there be a No Deal between the EU and UK, i.e. the two-year Article 50 process comes to an end without an agreement, will generate the highest losses.

Keywords: Brexit, Computable General Equilibrium Modelling

JEL classification: C68

1. Introduction

The referendum held on 23 June, 2016, to decide whether the United Kingdom (UK) should 'leave' or 'remain' in the European Union (EU) led to the 'leave' camp winning the vote by 51.9% to 48.1% of the electorate. The referendum turnout was 71.8%, with more than 30 million people voting. The UK result was mirrored in Wales with 'leave' accumulating 52.5% of the vote and 'remain' 47.5%. This was not the case in Scotland or Northern Ireland with 62% and 55.8% respectively voting to remain.

In March of 2017 the UK government triggered Article 50 of the Lisbon Treaty which signalled that the UK would leave or Brexit the EU in March 2019 at the end of the two-year period stipulated in that treaty. From the Welsh perspective, concern over the impact of Brexit on the Welsh economy is understandable given that Wales is more reliant in terms of exports to the EU than the UK as a whole; 67% compared to 49% for the whole of the UK.

Trading arrangements or regionalism has been a strong feature of international policy making since the 1950s (Perdikis, 2007). There are few, if any, precedents for a country leaving a trading arrangement. Once countries have entered into trading arrangements they tend to stay in them.

Renegotiations have certainly taken place but usually they involve the further reduction of trade barriers and the deepening of economic ties. Examples of these are the widening of the EU to incorporate the Nordic and Eastern and Central European countries and the establishment of the single market in 1992 (Kerr, 2018).

This lack of precedent makes it essential to understand the economic implications of leaving an existing agreement and what are the likely impacts of new trade arrangements once these are in place. The leave campaign was centred on several themes, namely the regaining of freedom to pursue an independent international trade policy, limiting immigration by controlling the UK's borders, regaining control and pursuing domestic laws and regulations as well as not making budgetary contributions set and agreed by the European Commission and European Parliament. In other words, by leaving the EU the UK would, as widely understood, regain its economic and political sovereignty.

At this time while the future nature of the EU–UK relationship remains uncertain and undecided amid all the noise, one can cling to one certainty: whatever the terms, whether cliff-edge exit or amicable separation, the UK will leave the EU at the end of March 2019 (Khorana and Vickers, 2018). There is, however, little clarity regarding the economic implications of Brexit and what sort of trade policy would be adopted following the UK's departure from the EU - the UK's largest trading partner. Two aspects about the run-up to Brexit are clear. First, the leave campaign did not espouse following a protectionist trade policy or in domestic terms a redistributive agenda. Open trade and free trade as well as new trade relationships with Commonwealth countries and the rapidly growing nations of China, India as well as the US were put forward as alternatives to the current membership of the EU. Secondly, the EU membership was considered not to have served the economic interests of the UK at large and, particularly, those who were perceived to have been left behind in the EU's widening and deepening. Further, the EU was considered to be protectionist in outlook, administratively bureaucratic, sclerotic and hence, stifling entrepreneurial initiative which Brexit would address.

The government has tried to provide some clarity on what form Brexit might take. The Prime Minister, in Lancaster House and Florence speeches, stated that the UK would leave both the customs union and the single market but seek to have as “close and deep” a relationship, as possible, with the EU by negotiating a bespoke trade agreement. The UK government has now confirmed its intention to leave the customs union and single market, and accepted the EU's formal text on transition arrangements published on the 7th of February 2018. The Welsh Government's policy position, supported by Plaid Cymru, is based on remaining in the customs union and the single market (Welsh Government, 2017). This is primarily attributed to the fact that Welsh trade is more dependent on the EU than the rest of the UK.

The UK government introduced as part of its negotiating strategy with the EU four red lines which it believed reflected the wishes of the leave voters. These included, control of immigration, the ability of the UK to make its own trade agreements and to be independent of the jurisdiction of the European Court of Justice (ECJ) or make any contributions to the EU budget. These red lines make

it unlikely that the UK will accept, as a permanent relationship with the EU, a Norway style option via membership of the European Economic Area (EEA): although this would be the Welsh Government's preferred option. Such a relationship would violate three of the red lines. Norway's relationship gives it access to the single market but in return it has to pay towards its operation (a budget contribution), accept the free movement of people and indirectly accept the jurisdiction of the ECJ. The ECJ does not have direct jurisdiction over EEA arrangements. These are overseen by the European Free Trade Area's (EFTA) court which follows the jurisprudence of the ECJ so closely as to make little difference in practical terms. Norway can though negotiate free trade agreements with the rest of the world.

It is also unlikely that the UK could embark on arrangements similar to those that Switzerland has with the EU as these too would be deemed unacceptable. The Swiss arrangement consists of a series of agreements covering various sectors of the economy but again the Swiss have to comply with the ECJ rulings, and accept the movement of labour. Once again, these arrangements would cut across the red lines.

A relationship similar to that which Turkey has with the EU would also be unacceptable to the UK. While Turkey does not have to accept the free movement of labour or contribute to the EU budget it does accept EU trade policy as a member of the customs union in manufactured goods. As a member of the customs union Turkey cannot negotiate and conclude its own trade agreements with other countries in these areas. To accept such an arrangement would mean that the UK would cross one of its red lines.

The UK government's preferred option seem to be an agreement that mirrors that which Canada has with the EU (CETA) but one including free trade in agriculture and financial services. This agreement would enable the UK to have its own immigration policy and negotiate its own free trade arrangement with the rest of the world and still have free access to the EU for its products. The UK would not be subject to the rulings of the ECJ nor would it have to contribute to the EU's budget. This type of trade arrangement is not though without its problems (Hobbs and Kerr, 2015). First, it does not give UK products unrestricted access to the single market. Products would have to be screened at some point as to their compliance with EU standards, rules and regulations. Secondly, UK products would have to meet and abide by the EU's rules of origin. Thirdly, non-access to the single market could be problematic for the financial services sector although some disagree with this view. The fragmented nature of the single market with regard to financial services may mean that the need to access it is not important given the costs involved. To access the single market in services would though require the UK to accept the jurisprudence of the ECJ and, therefore, cross a red line.

Slow progress in the initial Brexit negotiations with the EU over the UK's financial obligations to the EU, the complexities surrounding the nature of Northern Ireland border with the Republic of Ireland, EU and UK citizen rights and a lack of detailed clarity in the UK's proposed relationship with the EU, suggest the possibility that an agreement may not be reached before the withdrawal date is reached. If this is the case the UK and the EU will find that they will be trading with one

another under WTO rules. Some have argued that for both pragmatic and ideological reasons it would be best for the UK government to accept that this is going to be the likely outcome or the outcome for which it should aim.

The Welsh sectors most reliant on the EU as a principal export market are shown in Table 1. These are Food and live animals, Machinery and transport equipment, Manufactured goods, Chemical and related products, Misc manufactures, Animal & Veg fats and waxes, Mineral fuels, lubricants and related materials, Beverages and tobacco. In seven out of the ten categories listed in table 1 Wales is more reliant on the EU as a market than the UK as a whole. When it comes to the proportion of output accounted for by exports to the EU three sectors in Wales have a higher dependence than their counterparts in the UK.

Several Welsh industries and sectors are vulnerable to the post Brexit trade position; in particular machinery and transport equipment, commodities not elsewhere specified, manufactured goods, food and live animals and chemicals and related products. While a small proportion of the output of the food and live animal sector is exported to the EU it is the principal export market for beef and sheep meat (HCC, 2016). The processed food sector also finds the EU a major outlet. Given the perishability of its products, geographical proximity and ease of entry and no time consuming border checks are of major importance.

The machinery and transport equipment sector and the manufactured goods categories might be at particular risk from a hard Brexit. It may not be tariff rates that cause the principal problems but the lack of access to the benefits derived from membership of the single market. While EU import tariffs are low (circa 4%) they may have an impact on product costs as they cross the UK/EU border several times in the finishing process before they are incorporated into final products. The loss of single market benefits could also add to costs estimated to be in the region of 4%-10%. Hence clarity for Welsh producers as to what a post Brexit trade relationship with the EU would look like is paramount for those dependent on EU trade either directly or indirectly as part of a supply chain. Post Brexit policy for agriculture will also be critical. In the context of Wales, upland sheep farming would be particularly vulnerable to a WTO rules Brexit (HCC, 2016).

Table 1. Welsh exports to the EU by sector most affected include:

	Wales% to EU	%Sector share UK	% EU	% Sector share
Food and live animals	81	2	71	5
Beverages and tobacco	39	1	38	2
Crude materials (inedible) ex fuels	22	2	38	2
Mineral fuels, lubs and related	41	12	69	7
Animal and veg oils fats & waxes	44	0	78	0

Chemical and related products	59	12	54	18
Manufactured goods classified by material	67	16	55	9
Machinery and Transport equip	80	45	43	41
Misc manufactures	56	10	49	14
Commodities nes	88	1	16	2
Total	67	100	49	100

Source: National Assembly for Wales, HMRC data, 2016

The principal focus of this report is on the impact Brexit will have on the Welsh economy in terms of its trade, investment, GDP, per capita GDP and employment. Brexit's impact will be assessed by examining the implications of three different scenarios.

- (i) The first will assume that there is no deal with the EU at the end of the negotiating period and that trade with the EU and the rest of the world will be conducted on a WTO rules basis.
- (ii) The second scenario will examine a status quo arrangement remaining in place for a number of years (2, 3, 5 and 10). This arrangement implies a phased process of implementation to prepare for the new arrangements between the EU and UK. This would give businesses and individuals enough time to plan and prepare for those new arrangements
- (iii) The third will deal with a Canada style plus free trade agreement scenario with the EU under which tariffs on goods would be reduced.

In addition to this brief introduction the report proceeds to outline its methodology and provide an analysis of results for the three scenarios outlined above based using a dynamic computable general equilibrium (CGE) modelling framework. We conclude with a summary of our results and draw some comparisons with other studies conducted for the UK and some of its regions, including Wales.

2. Data and Scenarios Modelled

In this section we briefly summarise the model specifications and assumptions that underlay the analysis as well as the scenarios that were developed and simulated. The outcomes of these simulations are presented in the next section.

We use a dynamic CGE model based on the Global Trade Analysis Program (GTAP) 9.2 version of Data base to capture the dynamic effects of Brexit. To allow disentangling the effects of Brexit, from the perspective of its impact on the Welsh economy, we use a regional aggregation that includes: Wales, Rest of the UK, Rest of the EU, and the Rest of the World. The country aggregation employed for this study is at Appendix Table, A-1.

In the GTAP database, a total of 57 sectors are specified. The final list of sectors that are analysed along with sectoral mapping used for this study, can be found in Appendix Table A-2. Our starting point is the GTAP 9.2 Data Base, which has the base year of 2011.

The available macroeconomic and input-output (IO) data has been projected from the Welsh IO Table, and is used for running the model. The Welsh IO table was taken from the website¹ and shares of inputs compiled for each sector.² We obtained the following datasets from the IO table:

- a) Production by sector
- b) Consumption by sector
- c) Use of different intermediate inputs from different sectors in different industries for production.
- d) Use of primary inputs for production in each industry
- e) Exports and imports
- f) Various taxes
- g) Cost shares of each input in production costs (e.g. share of steel costs in auto industry production)
- h) Sales shares for each commodity in every industry (e.g. share of steel use in auto industry in total sales of steel across industries).

We also use the Social Accounting Matrix (SAM) and macro data (GDP, aggregate consumption, investment, exports, imports) for Wales for this study.

In the GTAP Database, the UK is a single country. We develop intra UK regions from the aggregate to be: Wales and the rest of the UK. For Wales, we used the IO table and macro-economic and trade data available; for the rest of the UK, we take the residual between the UK and Wales datasets. We employ *SplitReg*, a tool to disaggregate the UK into Wales and the rest of

¹ https://www.cardiff.ac.uk/__data/assets/pdf_file/0010/698869/input-output-tables-2007-final-30-6.pdf

² We obtained the Gross Value Added data, by industry, which is consistent with the GDP numbers, for 2011, for Wales and rest of the UK. Here is an excerpt from their documentation:

“..These tables are part of the regional gross value added (production approach) release published on the 16th December 2016. They show economic activity as measured by gross value added using the production approach (GVA(P)) for NUTS1 and NUTS2 regions of the United Kingdom including industry section totals. Estimates of workplace based GVA allocate output to the region in which the economic activity takes place. The constant price data underpinning these chained volume measures are not constrained to sum to the national total for each industry. Therefore they represent real growth in output, rather than in GVA.

More information can be found in quality note 2 of the accompanying statistical bulletin. **Source:** <https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgrossvalueaddedproductionapproachregionalgvapunconstraineddatatables>”

UK (i.e. Scotland, Northern Ireland, England).³ SplitReg multiplied the shares of the macrodataset to get the complete GTAP dataset for running the model. Thus, the Splitreg tool employs the share of Wales in UK in terms of industrial output, intermediate consumption in each industry, trade at bilateral level in each industry, and macroeconomic data, to split UK into these two regions. For this, it involves two steps:

- a) We simply share out all the data in UK GTAP region, into Wales and others. Before doing this, we need to make sure the year of reference and currency are the same in the IO table and GTAP. Since they are indeed different, the tool would just pick up the shares and use the macroeconomic data for 2011 in USD in order to be able to compare it with GTAP 2011 USD data for the UK as a whole. We also incorporate intra UK trade with no tariffs.
- b) The balance across sectors and regions needs to be restored, since splitting may have disturbed it. This is basically the overall supply-demand balance across sectors and regions. For this, Splitreg employs the widely used RAS method as well as the entropy method to do two things: first, we target the row and column totals of the matrix for the UK to make sure that the aggregate UK data is the same as that of GTAP; second, we minimize the entropy that captures deviations from balances.

We do not make any simplifying assumptions to split the data from an aggregate sector into disaggregated sectors; nevertheless, some of the sectors are disaggregated to get the GTAP sector total to 57. Wherever we required such a level of disaggregation, we assumed the cost and sales shares from the UK that are available in the GTAP 9 Data Base for 57 disaggregated sectors, in conjunction with the SAM data for the aggregated sectors. For example, if the IO table had textiles and apparel as one single sector, with all primary and secondary inputs used by this composite sector, we split this sector into separate textiles and apparel sectors by employing the share of textiles and apparel in their combined total in the GTAP Data Base. The Welsh sectors, included in the Welsh IO table, are split by the share of primary and secondary inputs of the combined total in the GTAP database. The methodology applied for this study is similar to an earlier study carried out by Narayanan and Khorana (2014) for detailed sectoral analysis in a multi-country framework.

We begin by developing a baseline (for 2011) to show what the world economy would look like without Brexit. In other words, this baseline is established on the basis of projected growth rates based on business-as-usual economic performance at the macro level (GDP, population and employment) and defined by a macro-econometric forecasting models. The baseline scenario used in this paper is established on the baseline developed by International Institute for Applied Systems

³ SplitReg has been developed to split regions that are commonly bundled together within the GTAP database, such as members of 'XOC' – Rest of Oceania, which include a multitude of Pacific Island nations (Horridge, 2011), and it could also be used to split one country based on simple weights.

To perform the split using SplitReg, the program requires only proportional value-added information for each sector of every new region. Sectors in other regions remain unchanged, and the sum of headers of new regions remain equal to the original region, thereby maintaining database balance.

Analysis (IIASA's) Sustainable Socio-economic Pathways (SSPs), which is in turn based on inputs from the World Bank and several other international organizations. Such scenarios provide different trajectories of growth in GDP, employment and population in the immediate future; they include the most pessimistic and most optimistic scenarios - we take a realistic scenario that lies between the two extremes. It contains information on macroeconomic variables as well as expected policy changes over 2007- 2050. The macroeconomic variables in the baseline include observations or projections for real gross domestic product (GDP), population, skilled and unskilled labour.⁴

For the purpose of this study, *three scenarios were developed*:

- a) **Scenario 1:** this assumes **No deal with the EU** i.e. Revert to WTO scenario in March 2019. This will reset UK relations with the remaining European members on a default World Trade Organization (WTO) rules basis. In the current context it means that there would be no formal agreement reached during the negotiations between the UK and the EU, which are taking place under the terms of Article 50 of the Lisbon Treaty. This also suggests that the UK would “crash out” of the trading agreement it has with the EU of which the UK is a member. There is a split amongst trade lawyers as to whether the UK can “grandfather these agreements. If the UK cannot then it will have to trade with its former partners on WTO terms.
- b) **Scenario 2:** this assumes that **an extension to Article 50 is agreed between the UK and EU. i.e. transition period allows for continuing status quo for a limited period of time, after which the current market access under the single market and applicability of the customs union would come to an end.** This means the extension of Article 50 between the EU and UK allows the economic relations to continue on current terms i.e. status quo to end at 2, 3, 5 and 10 years. In other words, this will provide for a period that will allow the continuation of current arrangements between the EU and UK for a number of years after Brexit.
- c) **Scenario 3: Canada-EU style agreement between the UK and EU,** based on the Comprehensive Economic and Trade Agreement (CETA). This scenario eliminates 98% tariffs between the UK and EU. and includes agricultural products. It does not include services and non-tariff barriers that would emanate under any trade agreement.

⁴ The database includes projections for population and economic development, which are the elements that are most used as basis of both integrated assessment and IAV studies. Specifically, for the following elements quantifications are available: population by age, sex, and education; urbanization; and economic development.

3. Main Findings of the Study

3.1 Scenario one: No Deal, i.e. Exit from the EU without a deal

This assumes that the **two-year Article 50 process comes to an end with no agreement**, and that the UK would leave the EU on 29 March 2019 with no deal in place.

This implies that the rules of the WTO rules would apply, i.e. tariffs would be imposed on goods traded between the UK and EU. It is assumed, based on the literature (Ciuriak, Dadkhah and Xiao, 2017), that tariffs on many industrial products would be 2-3%, but on cars these would be 10% and on many agricultural products between 20% and 40%.⁵

The effects of a No-Deal scenario are as below:

3.1.1 Real GDP

Tables 2 and 3 summarizes the macroeconomic impacts of the No Deal Brexit scenario on Wales, the rest of UK, the rest of the European Union and other regions of interest. Exit by the UK from the EU under the assumptions highlighted above generates significant negative impacts for the Wales economy, the Rest of United Kingdom, and the EU.

- By 2027-28, real GDP for Wales is expected to be lower by 0.5 % - 0.6% than would otherwise be the case, which is the moderate baseline from IIASA.
- Real wages of skilled and unskilled labour are expected to be lower by between 2.5 and 3% than would otherwise be the case.
- In general, real GDP declines in England, Scotland and Northern Ireland by the end of 2030. England is the most affected of the three and Scotland bears the smallest effect of Brexit by the end of the simulation period.
- The decline in real GDP for the rest of the European Union and Rest of the World is very marginal, ranging from - 0.01 % to - 0.04 % loss of GDP by 2030.

Table 2: No-Deal: Long-term impact (% Change from baseline: 2011)⁶

	% Change
Real GDP	-0.6
Exports	-19.7

⁵ The trade in services would also suffer if nothing was agreed in advance. Under a pure 'no deal' scenario, businesses would lose their passporting rights, which allow them to sell their services across the EU without having to obtain licences in each individual country.

⁶ In the baseline year (2011) population is shocked which means we assume that population grows over time, as a result the percent change in GDP and GDP per capita would be different. In terms of the % deviation in policy from baseline (which is reported here) if population does not change relative to the baseline, real GDP and real GDP per capita would grow at the same rate.

Imports	-4.9
Unskilled	-2.5
Skilled	-2.9

Source: Model simulations.

Note: Long term is to the end of the simulation year, 2030.

Table 3 shows how No Deal between the UK and EU impacts on other countries. Though there are no direct beneficiaries, the overall negative impact of the No-Deal scenario is concentrated in and around UK while the negative impact on other regions is either zero (USA) or rather muted (China and India, for example).⁷

Table 3: % GDP Impacts of No-Deal, Relative to Baseline, by country

Regions	2020	2025	2030
RestofUK	-0.41	-0.44	-0.48
Wales	-0.50	-0.55	-0.59
United States	0.00	0.00	0.00
China	-0.02	-0.02	-0.02
India	-0.03	-0.03	-0.02
Rest of EU	-0.04	-0.04	-0.04
Rest of the World	-0.01	-0.01	-0.01

Source: Calculations by the authors

3.1.2 Sectoral Impact

Figure 1 illustrates the long-term impact on sectoral output. We note that manufacturing sectors, such as petrochemicals and minerals, autos, machine equipment, etc., see the largest decline in output by the year 2030. Meat, livestock and other food sectors exhibit a similar declining trend by the end of 2030.

Further, any sectoral gains in the No-Deal scenario are concentrated in transport, communication and service sectors. This is because of the lower competition from imports in these sectors, which depend less on imports for their own production.

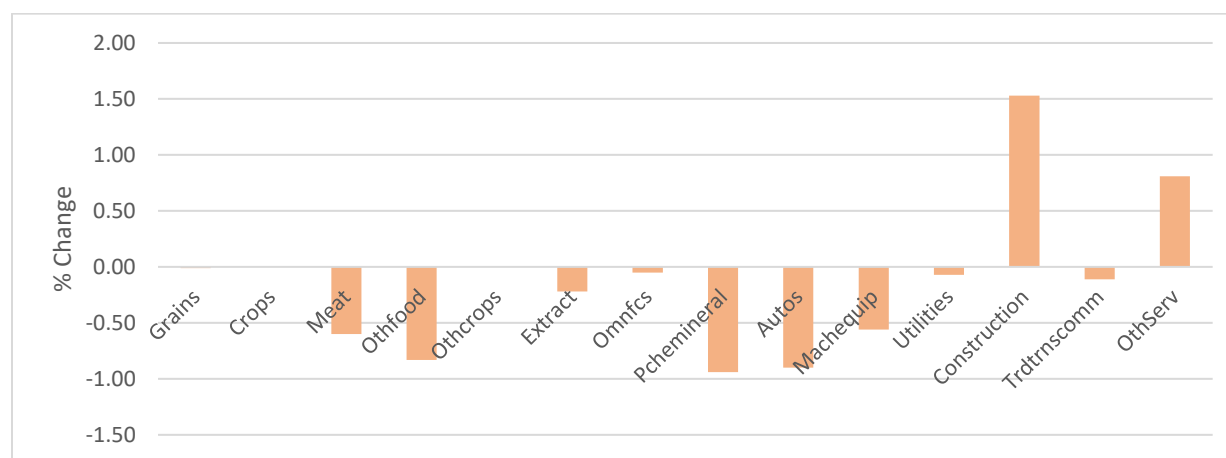
The food and agricultural sectors (represented here by crops and grains) see no substantial impact from the scenario under consideration. This is because some of them are perishable and not traded much;

⁷ Note that following Brexit some countries could benefit in terms of market share gains in both the UK and EU markets.

the traded commodities among them see some gains due to being shielded from imports. There are some demand losses due to increased prices, hence the positive and negative effects cancel out.

Note that the results are dynamic in that these are driven by a combination of factors including the direct EU-export intensity of the sector, size of the sector, sensitivity of the sector to competitiveness effects and regional linkages that evolve over years in future.

Figure 1: Long term changes in output in the No-Deal scenario (% change from baseline)



Source: Model simulations.

See the Appendix for definition of sectors and mapping to GTAP 57 commodities

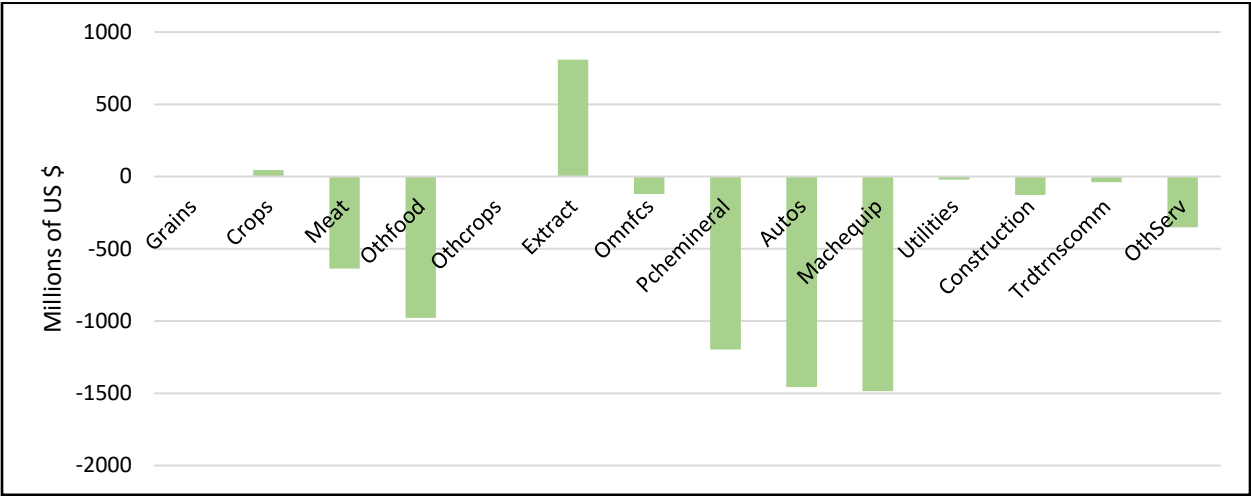
3.1.3 Trade Effect

Figure 2 presents the long-term impact (by end of 2030) of the No-Deal scenario on Current Account balance of Wales.

There is positive trade balance for the extraction sector, which includes forestry, fishing, and minerals, owing to greater increase in exports than in imports and some marginal gain from exports of crops. The reason for gains in exports is the reduced demand for imports, which lets the domestic production expand, to the extent that it can cater to increased exports, since domestic demand expansion is also small. But these gains are small compared to the general deterioration in the trade balance of other sectors by the end of the simulation period. As shown in table 4, the terms of trade effects⁸ are slightly positive for Wales.

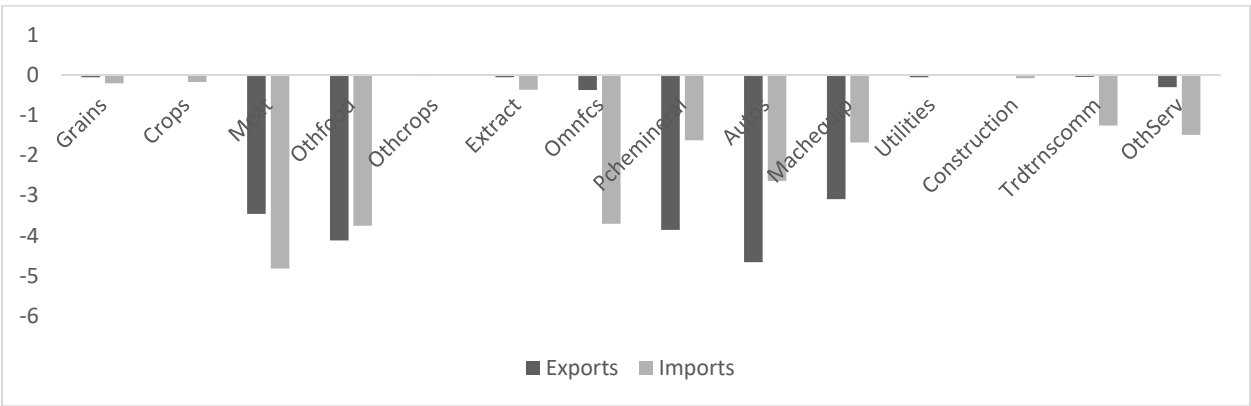
⁸ Terms of trade effects are defined as the changes in the relative price of imports in terms of exports, i.e., the ratio of export prices to import prices. It can be interpreted as the amount of imported goods an economy can purchase per unit of exported goods

Figure 2: Change in Trade Balance: Long term impact from the No-Deal scenario



Source: Model simulations.

Figure 3: Long term No-Deal scenario impact on Wales' Volume of Trade (% change from baseline)



Source: Model simulations.

Table 4: Long term impact of No-Deal in the terms of trade (% change from baseline)

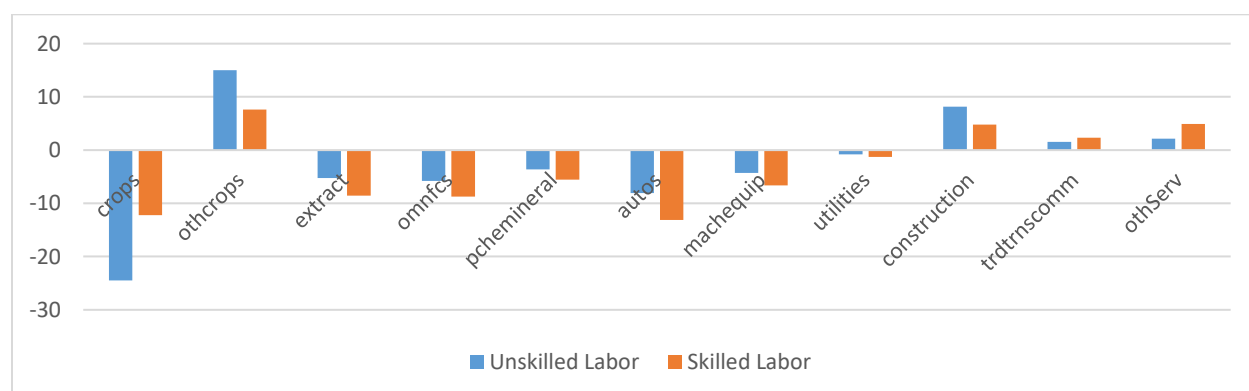
Countries	Terms of Trade Changes
RestofUK	2.08
Wales	0.60
United States	-0.24
China	-0.09
India	-0.13
Rest of EU	0.11
Rest of the World	-0.11

3.1.4 Employment Effect

Figure 4 presents the long term (2030) impact on skilled and unskilled labor demand by industries located in Wales. In the previous section, the impact of Brexit on sectoral output suggests that much of the positive impact will go to the service sector while other sectors, like manufacturing and extraction, see a downturn at the end of 2030. As a result, demand for labor, both skilled and unskilled, follows a similar pattern.

Given that labor income is an important component of household total income, the implication of such a sustained decline (as shown in Figure 4 employability of unskilled and skilled labor will have serious implications for income distribution and inequality in Wales.

Figure 4: Long term impact from the No-Deal scenario on labor employment
(% change from the baseline)



Source: Model simulations.

3.1.5 Investment Effect

Figure 5 represents the impact of such factors on the investment in Wales over the next decade and documents a declining investment across the years. This also contributes to the declining real GDP that is presented earlier.

As for Foreign Direct Investment, we see a similar declining trend to the tune of about 0.03-0.04%, and over time this effect gets more aggravated with greater negative effects (table 5).

Table 5: % Long term impact on FDI, Public and Private Investment: No Deal Scenario

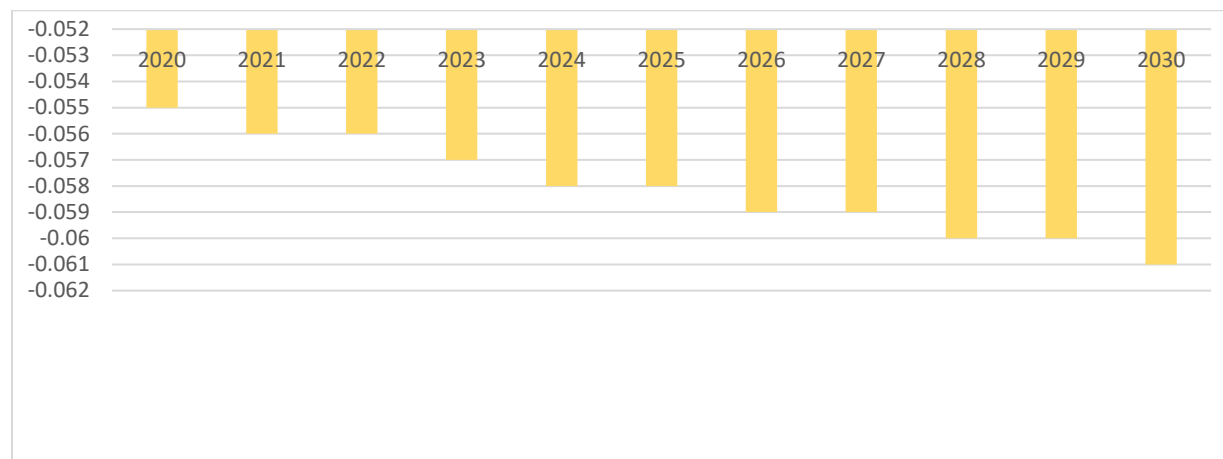
	FDI	Public Investment	Private Investment
2020	-0.03371	0.8576	-0.0622
2021	-0.03455	0.8504	-0.00045
2022	-0.03546	0.8431	-0.00055
2023	-0.03638	0.8359	-0.00055
2024	-0.0373	0.8286	-0.00055
2025	-0.03813	0.8214	-0.00045
2026	-0.03905	0.8141	-0.00055
2027	-0.03997	0.8069	-0.00055
2028	-0.04088	0.7997	-0.00055
2029	-0.04171	0.7924	-0.00045
2030	-0.04264	0.7852	-0.00055

Source: Model simulations.

Public investment increases mainly because of the increased tariff revenue⁹ due to which the public-sector investments have funding under the tariff collection arrangements after Brexit. But this type of investment, however, grows slower with time; in 2020, the growth is 0.86%, while in 2030 it is 0.79%. Private investment declines but at a slow rate and it gets flattened even more with time. In short, the investment effects are largely negative, with the exception of public investment.

⁹ One may argue that GDP reduction may outweigh increase in tariff revenue; however, this is an empirical question which can only be answered based on the relative changes to imports, tariff revenue and GDP. We observe that, given that GDP reduction comes mostly from falling exports and consumption, imports also fall due to a small boost in some of domestic production. Further, a rise in tariff revenue outweighs fall in imports. Due to this combination of multiple effects, we see the public investment benefit marginally despite a tariff hike.

Figure 5: Long term impact of the No-Deal scenario on investment
 (% change from baseline)



Source: Model simulations.

3.2 Scenario two: Continuation of Status Quo

Scenario 2: this assumes that **an extension to Article 50 is agreed between the UK and EU that allows for the continuation of the status quo**; that is remaining fully in the EU and its customs union and single market. This means the extension of Article 50 between the EU and UK allows the current economic relationship to continue on current terms within the existing structure of EU rules and regulations. This would effectively mean that the economic status quo would continue to apply, which besides the internal market also includes the customs union. The only difference is that Britain would no longer take part in decision making on European legislation. The scenario assumes that the status quo could continue to be in effect for a period of 2, 3, 5 and 10 years after UK's exit from the EU.¹⁰ In other words, during this limited period, the UK would continue to benefit from the existing arrangement with the EU. This would imply that the current arrangements will continue to be in place until the new 'bespoke' arrangement between the EU and UK is agreed, and that the UK has a transition arrangement in place.

3.2.1 Real GDP

Table 6 presents the long-term impact of continuation of the status quo on real GDP across select countries of interest.

¹⁰ While in reality, it may possibly matter as to whether this transition is agreed upon to begin with or not, in the model it doesn't matter as we observe the effects only after the UK exits. This is an essential abstraction for effective quantification of these effects as the business uncertainty arising from the uncertainty about transition is difficult to capture/model.

Table 6: Long term (2030) impact of continuation of the status quo on real GDP
(% change from baseline)

	2 year	3 year	5 year	10 year
RestofUK	-0.47	-0.46	-0.44	-0.40
Wales	-0.57	-0.56	-0.54	-0.50
United States	0.00	0.00	0.00	0.00
China	-0.02	-0.02	-0.02	-0.02
India	-0.02	-0.02	-0.03	-0.03
Rest of EU	-0.04	-0.04	-0.04	-0.04
Rest of the World	-0.01	-0.01	-0.01	-0.01

Source: Model simulations

For Wales, continuation of the status quo by 2, 3, 5 or 10 years brings a moderate improvement in economic gains relative to the hard Brexit scenario, i.e. No Deal. That is to say, the GDP loss by 2030 under the No Deal scenario is greater than any alternatives presented in Table 6.

Notwithstanding such a relatively positive effect of status quo, the overall message from Table 6 is that the continuation of status quo for a limited period is damaging to the economic wellbeing of the Welsh economy. In other words, if Wales does not have sufficient time with the status quo, it is likely to get adversely affected. This is because Wales can reap the benefits of being within the EU until Brexit happens, which means that delaying the exit could be useful to the Welsh economy, as it is for the rest of UK. While there is marked difference across countries in terms of losses to real GDP, the Welsh economy suffers the most (when compared with other regions in the UK) under status quo arrangements.

Table 7 presents the long run impact of the continuation of the status quo arrangement on some key macro-economic variables of interest. The figures reported are percentage changes from the 2011 baseline by the end of the simulation period, which is 2030.

Results suggest that continuation of the status quo brings substantial differential loss reduction in terms of macro impact to the Welsh economy. This is evident from substantial contraction in aggregate exports and decline in wages, both skilled and unskilled labor.

Table 7: Macroeconomic impact of status quo continuation (% change from baseline)

	2 year	3 year	5 year	10 year
Real GDP	-0.57	-0.56	-0.54	-0.50
Exports	-19.62	-19.57	-19.46	-19.24

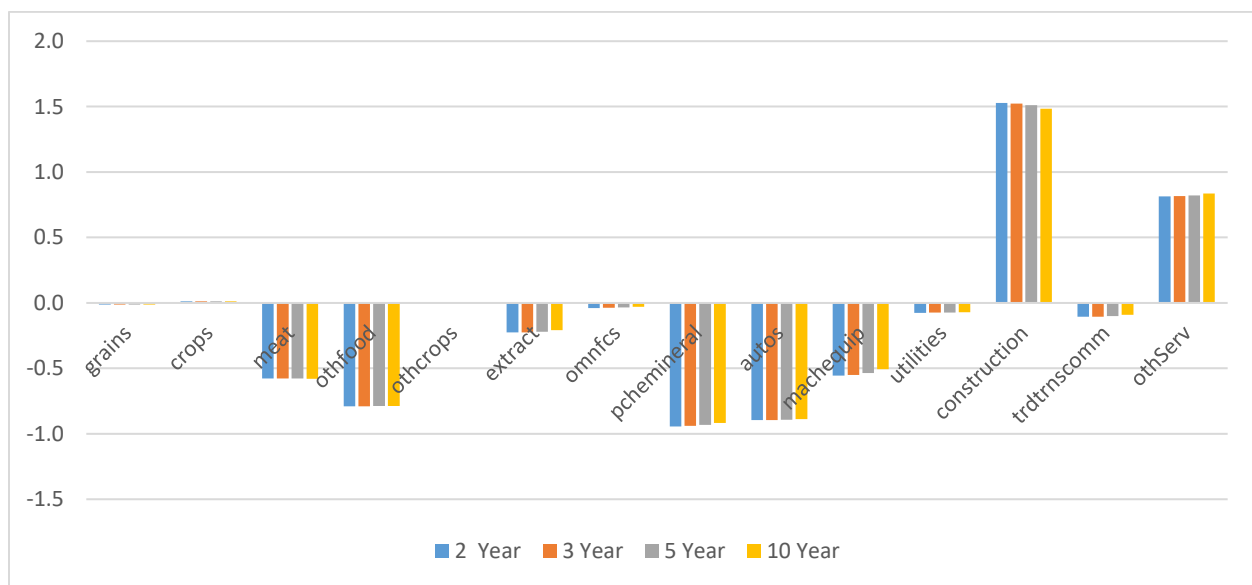
Imports	-4.89	-4.90	-4.92	-4.98
Real Wages				
Unskilled	-2.47	-2.46	-2.46	-2.45
Skilled	-2.75	-2.75	-2.74	-2.71

Source: Model simulations

3.2.2 Sectoral Impact

Similar to the No-Deal scenario, the long term output effect of continuing with the status quo are presented in Figure 6 in percentage changes in output, as deviation from the baseline in 2030. The figures indicate a structural shift for the Welsh economy away from manufacturing towards services.

Figure 6. Long term impact of the Status-quo on sector output (% change from baseline)



Source: Model simulations

The downturn in economic activity of the non-service sectors should be a cause for concern for policy makers. While there is no denying that the service sector could bring its own source of growth dynamics, without the growth in other supporting sectors, relying on the service sector to sustain economic growth and overall social wellbeing is a risky policy choice from the perspective of diversity in the economy.

The sectoral impacts differ slightly from the No-Deal scenario reported earlier. This reflects both the structure of the shock and the impact of the current scenario on services and the overall

manufacturing sector. The sectoral impacts also reflect the larger changes in real wages (see figure on employment effects), which is expected to have a differential impact depending on how skilled labour intensive a particular sector is and how sensitive sectors are to changes in competitiveness that is brought about in 2030 by the extended continuation of the status-quo. During the period of the status quo, there would be no changes in competitiveness relative to the baseline but this would change after the implementation of Brexit which would involve an arrangement to be decided between the UK and EU.

3.2.3 Employment Effect

The returns to factors employed in the production process (labor, for example) is an important indicator of the impact of policy on eventual income distribution.

Figure 7 shows that continuation of the status-quo is detrimental to the real payments to skilled and unskilled labor employed across sectors. This is a long-term impact and needs be considered as such with the implication that despite anticipated adjustments to the economy, both skilled and unskilled labor demand will decline and payments to those factors will fall in all the status-quo scenarios considered in the simulations. The fall in skilled labour is pronounced compared to real returns to unskilled labor because the sectors that employ skilled labour (manufacturing, pharmaceuticals, to mention a few) reduce their output/production the most while sectors that traditionally use unskilled labor (like grains and crops in our model) show little change in output contraction.

Figure 7: Long term impact of the status-quo on factor returns
(% change from baseline)



Source: Model simulations

3.2.4 Trade Effects

The Welsh Government publishes Export Statistics each year which provide an estimate of exports to the rest of the European Union. This helps identify those sectors which not only trade the most with the EU but also for which the EU comprises a large share of the UK's international export market.

Table 8 presents the structure of Welsh exports for 2011, the baseline year. This analysis identifies manufacturing, machinery and equipment, and automotive as some of the most prominent exports to USA, China, Rest of the European Union, and other countries. Wholesale and retail trade, transportation, communication and various professional services are the areas to focus upon among services sectors.

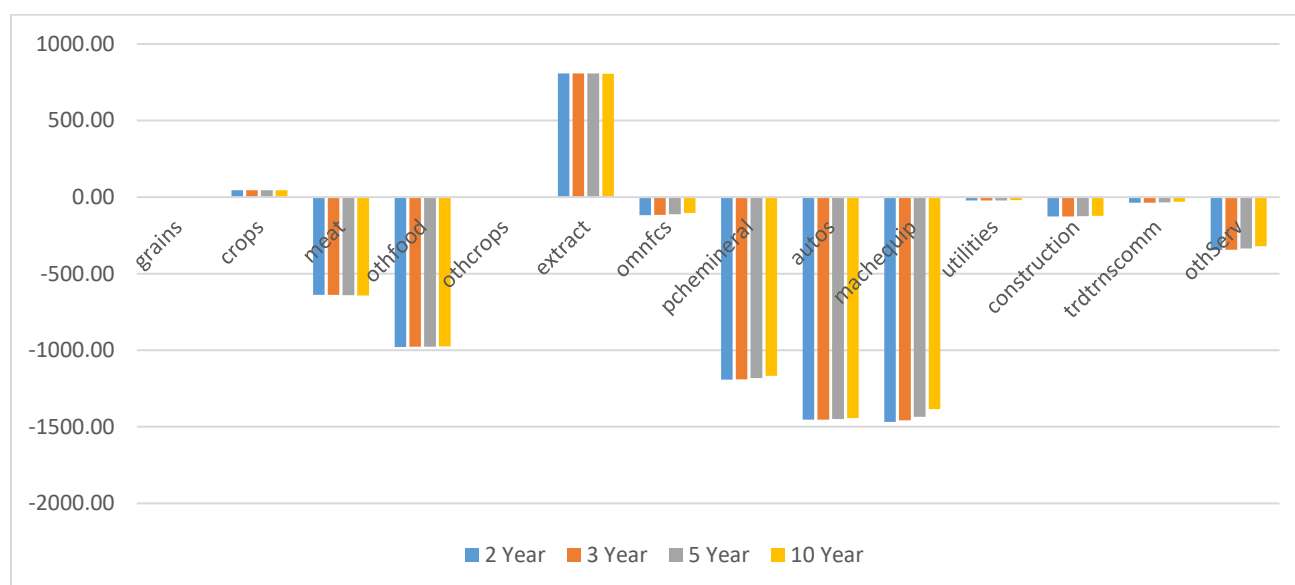
Table 8: Welsh exports by destination (% share for each country)

	USA	China	India	Rest of EU	ROW
Grains	0.00	0.00	0.00	0.00	0.00
Crops	0.00	0.00	0.00	0.10	0.10
Meat	0.10	0.20	0.00	1.00	0.30
Othfood	3.10	1.60	1.50	5.10	4.60
Othcrops	0.00	0.10	0.00	0.00	0.00
Extract	5.30	11.20	48.90	13.80	8.60
Other manufactures	2.60	10.50	3.50	4.30	4.20
Pchemineral	37.10	12.40	7.50	40.00	24.50
Autos	7.60	28.00	3.50	10.50	11.00
Machine Equipments	27.70	33.40	27.00	21.40	36.50
Utilities	0.40	0.10	0.40	0.50	1.10
Construction	0.00	0.00	0.00	0.00	0.10
Trade, transport & Communication	0.70	0.20	1.10	0.40	0.80
OthServ	15.50	2.30	6.30	2.40	8.00
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>

Source: GTAP Database 2011 and author's computations.

Given the structure of Wales's exports, it emerges that the hardest hit sectors from the continuation of the status-quo are manufacturing (automotive, machinery and equipment), extraction, and pharma-chemical sectors. This is shown in Figure 8. Again, this figure shows that continuing the status-quo (for two, three, five or ten years) has a marginal differential impact on the trade balance.

Figure 8: Trade balance effects of the status-quo (million US\$)



Source: Model simulation

As seen from table 9, the status quo scenario has less negative effects on both exports and imports in most industries, compared to the ‘no deal’ scenario. Since the effects occur almost in the year when the policy change happens, with no major effects in the other years, the effects are almost the same irrespective of when the status quo ends (2, 3, 5 or 10 years). In the terms of trade, as seen from table 10, Wales gains slightly.

Table 9: The long term (2030) Impact of Status-quo on Wales’ export and imports (% change from baseline)

Products	Exports				Imports			
	2 Year	3 Year	5 Year	10 Year	2 Year	3 Year	5 Year	10 Year
Grains	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Crops	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Meat	-3.5	-3.5	-3.5	-3.5	-1.7	-1.7	-1.7	-1.7
Other food	-4.1	-4.1	-4.1	-4.1	-1.3	-1.3	-1.3	-1.3
Other crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Extract	-0.1	0.0	0.0	0.0	-1.8	-1.8	-1.7	-1.7
Other mnfcs	-0.4	-0.4	-0.4	-0.3	0.0	-0.1	-0.1	-0.1
Petrochemical	-3.8	-3.8	-3.8	-3.8	-0.7	-0.7	-0.7	-0.7
Autos	-4.7	-4.6	-4.6	-4.6	-0.7	-0.7	-0.7	-0.7
Mach equipment	-3.0	-3.0	-3.0	-2.9	0.7	0.7	0.7	0.6
Utilities	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0

Construction	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3
Trade transport and communication	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Services	-0.3	-0.3	-0.3	-0.3	0.5	0.5	0.5	0.4

Source: Model simulations.

Table 10: Long term (2030) impact of maintaining the status-quo on terms of trade (% change from baseline)

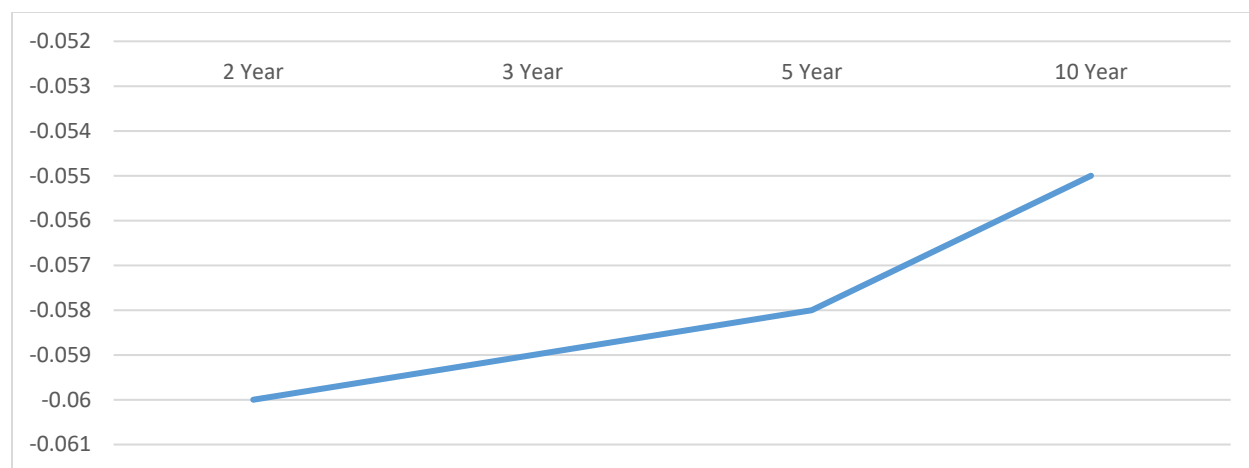
Countries	2 Year	3 Year	5 Year	10 Year
RestofUK	2.0	2.0	2.0	1.9
Wales	0.6	0.6	0.6	0.5
United States	-0.2	-0.2	-0.2	-0.2
China	-0.1	-0.1	-0.1	-0.1
India	-0.1	-0.1	-0.1	-0.1
Rest of EU	0.1	0.1	0.1	0.1
Rest of the World	-0.1	-0.1	-0.1	-0.1

Source: Model simulations.

3.2.5 Investment Effect

The overall impact of the continuation of status-quo on investment is negative, but it improves with a longer transition period. Figure 9 shows the long term (2030) impact on investment. The economy faces an initial negative shock to investment, which may aggravate with time; therefore, the later the beginning of shock (losing the status quo), the less negative is the effect on investment. Like we saw in the ‘no deal’ scenario, we observe a marginal change in FDI (about 0.03-0.04% reduction in FDI), considerable increase in public investment (about 0.8-0.9%) and marginal decline in private investment (about 0.0004%). There are not many large differences across the transition periods, but broadly, we observe that the greater the transition period, the lower the negative impact on private investment and FDI and the lower the positive effect on public investment.

Figure 9: Long term impact of status-quo on investment (% change from baseline)



Source: Model simulations.

3.3 Scenario three: Canada style UK-EU Free Trade Area

This section presents the economic impacts of the UK forming a CETA style FTA with the European Union. This agreement, for example, eliminates 98% of tariffs between Canada and EU. It does not, however, necessarily eliminate all non-tariff barriers.

As with other such regional trade agreements, this FTA is supposed to eliminate bilateral tariffs. Here we assume that implementation of the FTA is undertaken in 2019. We should stress that this exercise is undertaken to highlight the alternative routes the UK could potentially take to help mitigate the negative impact of Brexit that was highlighted in the previous sections.

3.2.1 Real GDP

Table 11 presents the macroeconomic results for alternative policy options.

First, as far as Wales is concerned, UK-EU FTA brings substantially different macroeconomic results compared to the No-Deal scenario presented earlier. The FTA provides an improvement over the Brexit long term outcome of a No deal and the economic gains are spread in all areas of macroeconomic indicators. For example, looking at the first row in Table 6, the long term growth impact of the FTA provides a marked improvement over that of Brexit's long term outcome with no deal between the UK and EU. A similar trend is observed when examining output and the trade balance results.

Second, while the long term impact of a UK-EU CETA style FTA are not necessarily positive, it represents a marked improvement over the Brexit scenarios we considered earlier. This is driven by a marked change in the long term impact on output of specific sectors (for example, manufacturing) and substantial improvement in the trade balance of Wales.

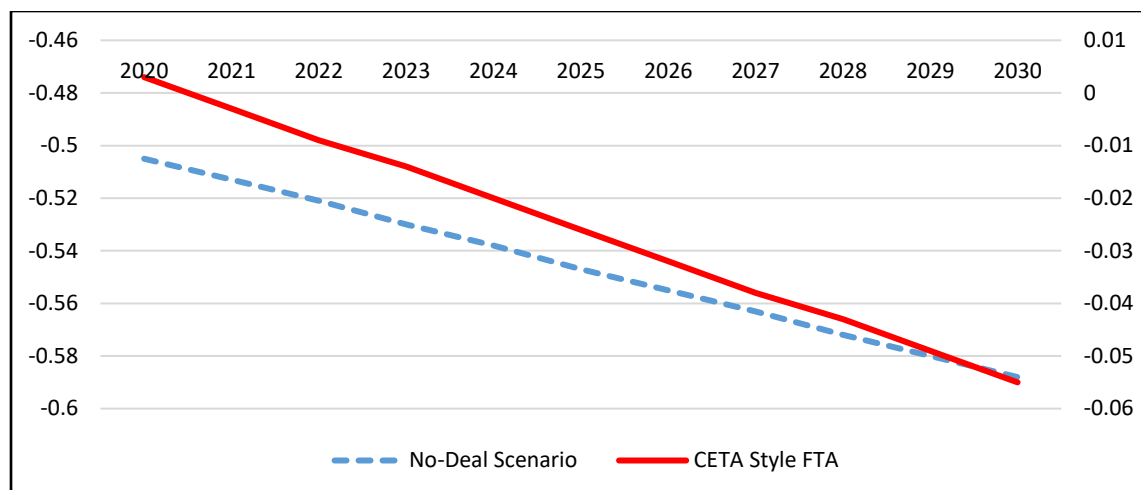
Table 11. Long-term macroeconomic impact of alternative scenarios until 2030 (% Change from baseline)

	Status Quo				No-Deal Scenario	CETA- Style FTA
	2-yr	3-yr	5-yr	10-yr		
Real GDP	-0.57	-0.56	-0.54	-0.50	-0.59	-0.06
Exports	-19.62	-19.57	-19.46	-19.24	-19.70	-0.91
Imports	-4.89	-4.90	-4.92	-4.98	-4.87	-0.10
Unskilled	-2.47	-2.46	-2.46	-2.45	-2.47	-0.13
Skilled	-2.75	-2.75	-2.74	-2.71	-2.76	-0.12

Source: Model simulations

Figure 10 presents the overall growth pattern of the Wales economy under hard Brexit and UK-EU FTA through to 2030. Please note that the red line (growth of GDP under the UK-EU FTA) has the y-axis on the right side of the picture, and that side has a much smaller scale compared to the y axis on the left hand side. What this means is that while both Brexit and UK-EU FTA lead to economic downturns over the next ten years, the magnitudes of these scenarios are markedly different. Under the UK-EU FTA, Wales real GDP is expected to be between 0.01 and 0.06 percent lower than otherwise would be the case in 2030.

Figure 10: Growth patterns of real GDP under alternative trade regimes (% change from the baseline)



Source: Model simulations

3.3.2 Sectoral Impact

If the UK concludes an agreement with the EU on CETA lines, UK-EU goods trade would continue to be tariff free and there would be no new barriers to trade between the UK and the EU, and these would be primarily non-tariff barriers but a set of rules of origin would apply. Note that a FTA between the EU and UK on the CETA model would not provide the same level of market access as membership of the Single Market, as it would not include services.

Concluding a CETA style FTA after Brexit would lead to the smallest increase in UK-EU trade costs and our analysis below shows it is the least bad option for the Welsh economy. Table 12 compares the cumulative percentage change in output from the baseline by 2030 following a No Deal scenario and a CETA style UK-EU FTA.

Overall, the Welsh sectors that would be most negatively affected by the exit of the UK from the European Union would be automotive production, meat and agricultural processing industries and the pharma-chemical manufacturing sectors. The hardest hit sector from the UK-EU FTA is the meat production and processing sector, while the rest of the Welsh economy shows marginal declines.

Table 12: Long term output impact of alternative trade scenarios
(% change from baseline by 2030)

Sectors	No-Deal	CETA-Style FTA
Grains	-0.01	0.00
Crops	0.00	0.00
Meat	-0.60	-0.17

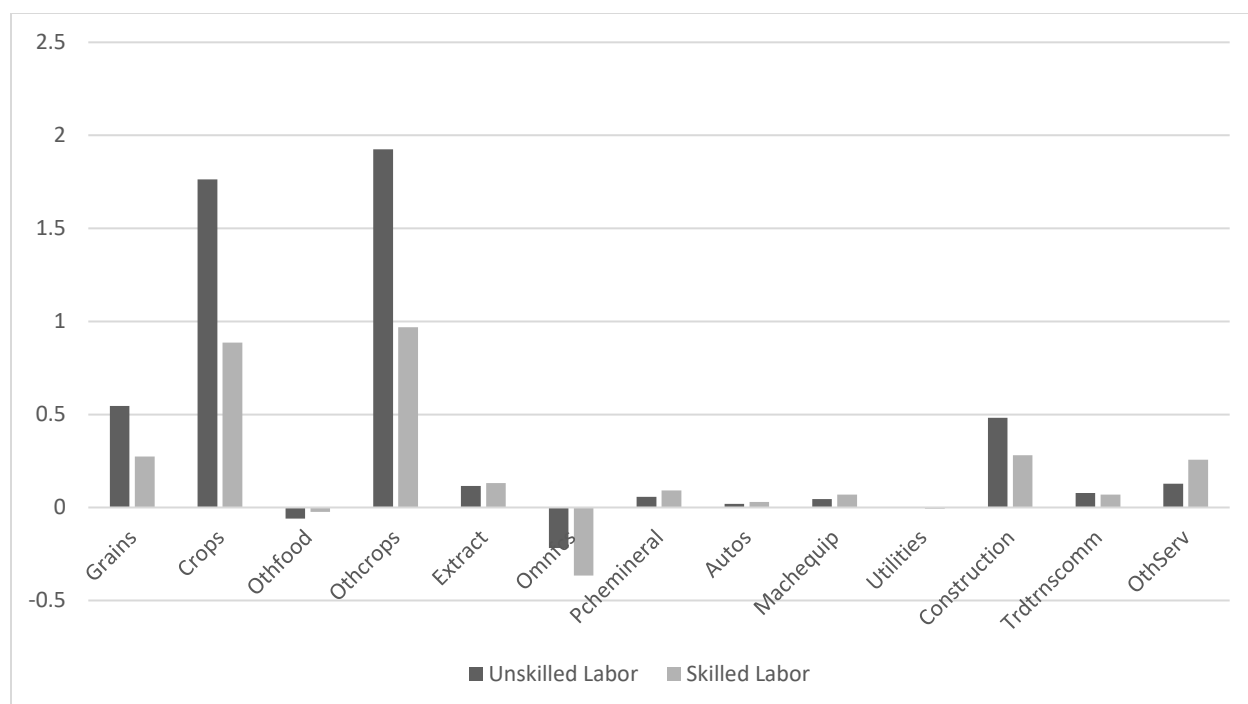
Othfood	-0.83	-0.01
Othcrops	0.00	0.00
Extract	-0.22	-0.01
Omnfcs	-0.05	-0.01
Pchemineral	-0.94	-0.02
Autos	-0.90	0.00
Machequip	-0.56	-0.01
Utilities	-0.07	0.00
Construction	1.53	0.09
Trdtrnscomm	-0.11	-0.02
OthServ	0.81	0.02

Source: Model simulations.

3.3.3 Employment Effect

Figure 11 presents the long term (2030) impact of the UK-EU CETA style FTA on skilled and unskilled labor demand by industries located in Wales. In the previous section, i.e. No Deal and CETA scenarios, we have seen the impact of Brexit on sectoral output and told the story that much of the positive impact will go to the service sector while other sectors like manufacturing and extraction see downturns at the end of 2030. Here the story is quite the opposite. What we see in in Figure 11 is that there is little output contraction following the UK-EU FTA and, hence, the changes in demand for skilled and unskilled labor are both small and follow the direction of output change.

Figure 11: UK-EU FTA based on CETA: impact on labor demand
(% change from the baseline by 2030)



Source: Model simulations.

Note: skilled labor demand for the meat sector declined by 31% while demand for unskilled labour by the same sector declined by about 24%. These changes were too big to put in the same figure as the changes in labor demand by the other sectors. Hence, we removed the bars for labour demand changes by the meat sector.

3.3.4 Trade Effects

In the terms of trade effects (Table 13 xx), the sectors that would be negatively affected by the exit of the UK from the EU would be machinery and equipment production, the automotive sector and the pharma-chemical manufacturing complex.

This picture completely changes once the UK forms a CETA style FTA with the EU (Table 13). Now, the overall structure of the trade balance, while qualitatively the same, improves in magnitude. That is to say, more often than not, the sectors that suffer under a no deal Brexit still show negative trade balances under a UK-EU FTA but the deficit in trade balance is smaller in magnitude.

Table 13: Long-term impact of alternative trade deals on the Trade Balance for Wales: 2030 (Million US\$)

Sectors	No-Deal	CETA-Style
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	Scenario	FTA
Grains	-1	2
Crops	45	4
Meat	-638	-213
Othfood	-978	6
Othcrops	1	0
Extract	808	-6
Omnfcs	-121	-8
Pchemineral	-1198	-2
Autos	-1457	-11
Machequip	-1486	-55
Utilities	-22	-1
Construction	-128	-8
Trdtrnscomm	-39	-2
OthServ	-352	-21

Source: Model simulations.

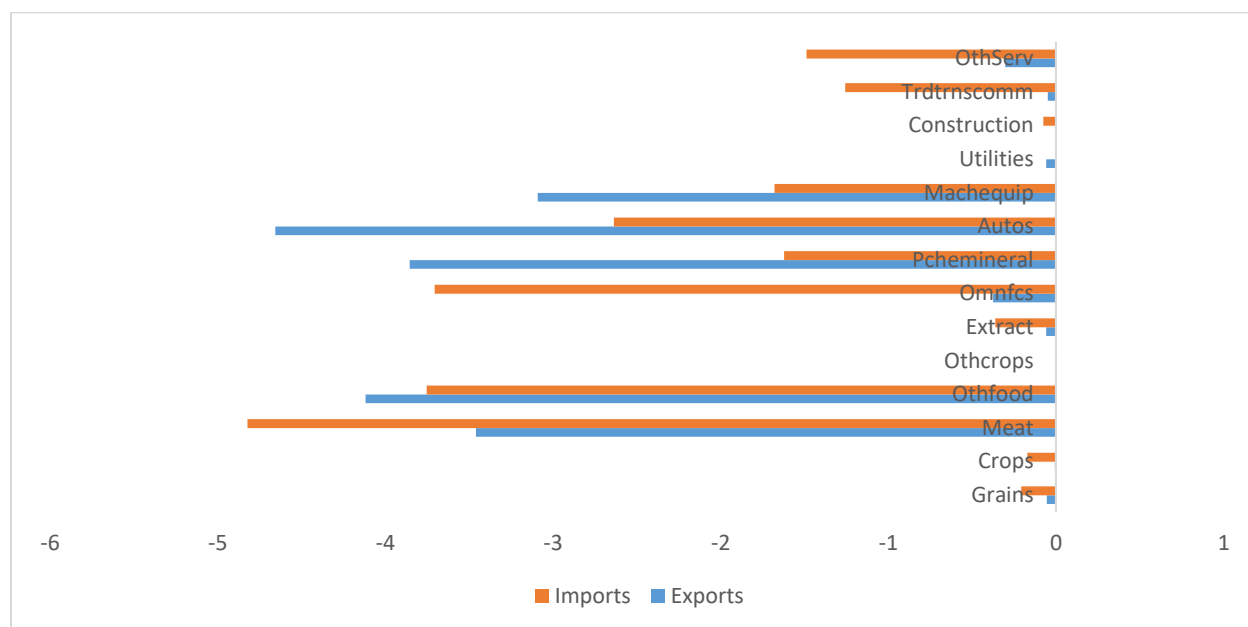
Table 14 (and figure 12) show the aggregate changes in imports and exports across policy scenarios by comparing results for different countries of interest. Again, both exports and imports show improvement, in absolute terms, compared to the no deal Brexit scenario. It is clear from table 13 that all four members of the UK stand to lose under a no Deal scenario. The situation is not as dire in the CETA scenario but there are still declines in exports. The terms of trade effects on Wales from a CETA style scenario is positive but negligible (table 14).

Table 14: Long term trade impact of alternative scenarios: 2030
(% change from baseline)

Countries	No Deal		CETA style FTA	
	Exports	Imports	Exports	Imports
RestofUK	-21.75	-3.19	-1.13	0.03
Wales	-19.70	-4.87	-0.91	-0.10
United States	2.00	-0.67	0.05	-0.02
China	1.19	-0.27	-0.01	0.01
India	1.68	-0.36	0.01	0.00
Rest of EU	-1.61	-0.42	0.00	-0.03
Rest of the World	0.81	-0.34	0.04	-0.02

Source: Model simulations

Figure 12: Long term CETA-Style scenario impact on Wales' Export and Import (% change from baseline)



Source: Model simulations.

Table 15: Long term impact from CETA-style FTA on the terms of trade: 2030 (% change from baseline)

Countries	Terms of Trade
RestofUK	0.20
Wales	0.03
United States	-0.01
China	0.00
India	0.00
Rest of EU	-0.01
Rest of the World	-0.01

Source: Model simulations.

3.3.5 Investment effects

There are still small negative effects on investment as a result of a CETA-style FTA (Table 16), but there is an initial bump in FDI that fades off and becomes negative over time. The initial bump comes from reduced imports that may induce foreign firms to invest in Wales to substitute imports –called tariff-escalating investment in literature. Public investment increases strongly, albeit with a diminishing growth over time – from 0.8-0.86%. Private investment faces a small decline.

Table 16: Investment effects of CETA-style FTA (% change from baseline)

	Total Investment	FDI	Public Inv	Private Inv
2020	-0.0005	0.00002	0.8576	-0.0622
2021	-0.0011	-0.00079	0.8504	-0.00045
2022	-0.0017	-0.0016	0.8431	-0.00055
2023	-0.0023	-0.00241	0.8359	-0.00055
2024	-0.003	-0.00331	0.8286	-0.00055
2025	-0.0036	-0.00412	0.8214	-0.00045
2026	-0.0042	-0.00493	0.8141	-0.00055
2027	-0.0048	-0.00575	0.8069	-0.00055
2028	-0.0054	-0.00656	0.7997	-0.00055
2029	-0.006	-0.00736	0.7924	-0.00045
2030	-0.0066	-0.00817	0.7852	-0.00055

Source: Model simulations.

4. Summary and Discussion

Based on our analysis of different scenarios, namely, ‘no deal’, ‘status quo’ and a ‘CETA-style FTA’, the main findings suggest that all scenarios lead to losses for the Welsh economy.

The ‘status quo’ scenario is the least negative. The longer the transition period, the less negative are the macro, output, trade and investment effects of this scenario.

The next least negative is the CETA style agreement. The most negative for the Welsh economy is if the UK were to revert to the WTO terms under the no agreement scenario. We conclude that no deal is certainly not a sensible option for the Welsh economy. It is in recognition of this that both the Economists for Free Trade (2016) and Policy Exchange analyses propose that the UK should adopt a unilateralist approach to the removal of trade restrictions and reduce regulations and standards to a minimum in order to cut costs to domestic firms.

There are serious questions regarding the analyses carried out by the Economists for Free Trade group. For example, they assume that the differences seen in producer prices between the EU/UK and the rest of the world are the result of EU regulations and account for 10% of the differences in prices. Eliminating these EU regulations would lead to lower prices in the UK and also give UK produced goods a competitive edge in international markets. It has been argued that this approach is wrong in that price differences could be the result of EU consumer preferences for higher quality and therefore more expensive products (Sampson, et al, 2017). There are also doubts regarding the quality of the price data used and therefore its applicability (Sampson et al, 2017) The removal of EU regulatory standards would not necessarily have a positive impact on firm output and competitiveness (Winters, 2017).

The Economists for Free Trade also misunderstand the positive role of regulatory standards. Standards can remove uncertainties in the market place for consumers and encourage producers to improve product quality (Issac et al, 2004). In any case lower quality products that did not meet EU standards would be excluded from the EU so it is unlikely that there would be any cost savings to UK firms as a result of their removal or reduction. In any case UK producers would have to meet the standards set in other countries to achieve access to their markets. It is therefore unlikely that the removal of EU regulatory standards *per se* would have much of a positive impact on exports. Domestic working practices and regulations are another matter. The UK would be able to change these and they might have an impact on costs of production.

A further issue with the Economists for Free Trade is the impact that the unilateral reduction in trade barriers would have on domestic industries. They acknowledge that there would be a rapid decline in manufacturing and the agricultural sectors and as a result an adverse impact on the distribution of income. While it is inevitable that in the long run these sectors may decline as comparative advantage shifts away from the UK to other locations the economic and social impacts on Wales could be very severe in the short to medium term.

Our results tend to support the work recently carried out by several bodies and institutions on the impact of Brexit (Black, 2017; Fraser of Allander Institute, 2016; Dhingra, et al, 2016; Dhingra et al, 2017; Scottish Government, 2018; Khorana and Vickers, 2018). Values arrived by the studies vary as a result of applying different methodologies and starting points and scenarios but they indicate that Brexit would have a negative impact on the UK and the regions on which they carry out their studies. Dhingra, (2017) calculates the local economic effects by county and presents estimates among others for Wales (see table A3).

As we were putting together the final draft of our report the Welsh Government published its Trade Policy: the issues for Wales (Welsh Government, (2018). The report incorporates work carried out by Cardiff University Business School which summarises the sectors in Wales most at risk from Brexit. It differs to our study in quantifying the Welsh sectoral losses to be incurred from Brexit. Given our limited resources and time constraints our report concentrated on four impacts arising from Brexit. These were the expected direct and indirect effects of tariffs on exports, the effect of tariffs on firm inputs, the effect of non-tariff barriers on firm inputs and sectoral trade and activity and finally the effects on the Welsh economy of changes in sector activity. The Cardiff Business School study included those aspects as well as taking into account the labour market risks associated with Brexit, losses resulting from the loss of access to EU sectoral networks and institutions, firm investment decisions as a result of maturing product cycles and firms' strategic locational decisions with regard to production and other forms of activity.¹¹ Had our study included these aspects it is likely that the losses we identify would have been larger and more in line with their results.

Interestingly the report identifies Aerospace systems and services, the automotive sector, Electrical engineering components and semiconductors, Chemicals and steel as high risk sectors most vulnerable to the imposition of tariff and non-tariff barriers on their output and or inputs. Those with medium risk involved Food and drink, Information and communications technology, Medical/Health products and services and other advanced manufacturing and engineering. The sectors most vulnerable from the imposition of trade barriers overlap with our own to a considerable extent although sectoral definitions differ slightly. Interestingly that report, highlighting the views of the Confederation of British Industry, the Federation of Small Business and the British chambers of Commerce, also calls for a lengthy status quo transition period. It envisages a WTO rules based trading relationship as the worse possible case for business.

Our study shows that both the EU and the rest of the world will also be negatively affected by Brexit although to a smaller extent. It is sobering to see that the negative GDP impact of Brexit on the EU is estimated to be in the region of -0.04% whereas for Wales it ranges from -0.5% to -0.59% over the period under study. For the rest of the UK the figure ranges from -0.41% to -0.48%.

These figure might well shape and impact on the way the negotiations with the EU are conducted. If we accept that a smaller market in terms of GDP will mean a loss of economic welfare for both

¹¹ See: <http://gov.wales/topics/businessandconomy/welsh-economy/eu-transition-and-economic-prospects-for-large-and-medium-sized-firms-in-wales/?skip=1&lang=en>

parties it follows that both will be required to increase their individual share of a smaller market if they want to maintain their previous levels of economic welfare. Negotiations could, therefore, prove difficult from the UK perspective particularly as the EU loses less proportionally to the UK and

Public investment will see an increase under all these scenarios, mainly because of the revenue boost from higher tariffs¹². There may be some crowding out of FDI and private investment, partly because of the fact that costs in the economy rise and consequently, expected returns on investment fall over time in all these scenarios. We have not adjusted the flow of public funds in line with the Barnett formula which could reduce the funds available for public spending in Wales.

Renegotiating the UK's relationship with the EU starting from a position of relative weakness is difficult for businesses. Firms and, in particular, multinational companies need to have a clear understanding of the business environment in which they are operating as it will impact on both their production and location strategies. It is accepted that firms like to influence and engage with government in the formulation of economic policies that will impact on them (Lawton, et al 2009). Once the policies have been formulated firms then need to absorb what has been or is to be implemented and accordingly adjust their corporate strategies with regard to product quality, design production methods, and location. Finally firms will need to engage with any aspects of compliance and enforcement that the policy requires. Hence clarity in understanding what goals have been set by the UK government is paramount. The lack of clarity in the goals to be achieved in the Brexit negotiations and in particular the details involved makes it very difficult for UK and Welsh business to engage properly with the process.

5. Conclusion

The scenario simulations reveal that Brexit will lead to the imposition of costs, either through the imposition of tariffs or the loss of preferential access to the single market. The impact on the Welsh economy will be felt via reductions in GDP, GDP per capita, trade, investment and employment. The least costly outcome for Wales is if the status quo can be held to for as long as possible. The next best or next least worst is the conclusion of a CETA type agreement with the EU. The most costly is a Brexit based on WTO rules.

Our results chime with both economic theory and empirical work carried out by the majority of other researchers as well as those of the Welsh Government laid out in their recent document on Trade Policy.

¹² While we don't make a specific assumption that an increased tariff revenue in the UK will lead to greater public investment in Wales, such a possibility is consistent with the closed accounting nature of a CGE model; all income and expenditure should equal, meaning that any increase in the government's tax revenue must partly be used for public investment. Since we consider Wales as a separate region herein, the tariff revenue that is available for Welsh public investment is just a portion of the share of Wales in total UK tariff revenue. To this extent, we capture the fact that only a small portion of UK tariff revenue may be used to support/provide Welsh public investment.

From the point of view of theory moving from a relatively “free trade” position with a partner to something less will inevitably lead to losses in economic welfare (Viner, 1950).

For those negotiating Brexit with the EU or attempting to influence those negotiations the principal objective should be to mitigate the costs involved as far as possible. This can be achieved either by obtaining an arrangement that will grant as much access to the EU for Welsh products and/or undertaking domestic policy changes to reduce the costs to business. Some researchers have advocated that the UK should adopt a unilateral free trade policy and remove domestic regulations to achieve these lower costs. We have not attempted to review this policy proposal in the context of Wales in this report but respectfully suggest that this might be an avenue to pursue in order to clarify such a policy’s impact on Wales.

While a free trade policy is accepted amongst economists as maximizing economic welfare, in particular for a “small” country its success is dependent on there being a well-functioning multilateral system based on internationally accepted rules and policed by a dispute settlement procedure to which all nations ascribe (Kerr and Perdakis, 2014). In the current international climate there are concerns as to whether this multilateral system will operate as it has in the past. If uncertainties arise and the multilateral system breaks down it is likely that countries will adopt protectionism and “beggar thy neighbour” policies. Should that situation arise then countries finding themselves outside economic blocs and arrangements will come under severe economic pressure.

From the policy perspective there is “not a moment to lose”. If the negotiating partners cannot meet the deadline of the key European Council meeting on the 22-23 March, the start of trade talks could be pushed back, possibly even beyond the next formal EU summit in late June. This would jeopardise hopes of having an outline trade accord ready by the end of the year and lead to trade with the EU on WTO rules.

Table A1. GTAP 57 sector classification and mapping used for analysis

No.	GTAP 57	Long Name	Aggregate Sectors
1	Pdr	Paddy rice	Grains
2	Wht	Wheat	Grains
3	Gro	Cereal grains nec	Grains
4	v_f	Vegetables, fruit, nuts	Crops
5	Osd	Oil seeds	Crops
6	c_b	Sugar cane, sugar beet	Crops
7	Pfb	Plant-based fibers	Crops
8	Ocr	Crops nec	Crops
9	Ctl	Cattle,sheep,goats,horses	MeatLvstk
10	oap	Animal products nec	MeatLvstk
11	rmk	Raw milk	OthFood
12	wol	Wool, silk-worm cocoons	Crops
13	Frs	Forestry	Extraction
14	fsh	Fishing	Extraction
15	coa	Coal	Extraction
16	oil	Oil	Extraction
17	gas	Gas	Extraction
18	omn	Minerals nec	Extraction
19	cmt	Meat: cattle,sheep,goats,horse	MeatLvstk
20	omt	Meat products nec	MeatLvstk
21	vol	Vegetable oils and fats	OthFood
22	mil	Dairy products	OthFood
23	pcr	Processed rice	OthFood
24	sgr	Sugar	OthFood
25	ofd	Food products nec	OthFood
26	b_t	Beverages and tobacco products	OthFood
27	tex	Textiles	Omnfcs
28	wap	Wearing apparel	Omnfcs
29	lea	Leather products	Omnfcs
30	lum	Wood products	Omnfcs
31	ppp	Paper products, publishing	Omnfcs
32	p_c	Petroleum, coal products	Chemineral
33	crp	Chemical,rubber,plastic prods	Chemineral
34	nmm	Mineral products nec	Chemineral
35	i_s	Ferrous metals	Extraction
36	nfm	Metals nec	Extraction
37	fmp	Metal products	Extraction

No.	GTAP 57	Long Name	Aggregate Sectors
38	mvh	Motor vehicles and parts	Omnfcs
39	otn	Transport equipment nec	Machequip
40	ele	Electronic equipment	Machequip
41	ome	Machinery and equipment nec	Machequip
42	omf	Manufactures nec	Omnfcs
43	ely	Electricity	Utilities
44	gdt	Gas manufacture, distribution	Utilities
45	wtr	Water	Utilities
46	cns	Construction	Construction
47	trd	Trade	Trdtrnscomm
48	otp	Transport nec	Trdtrnscomm
49	wtp	Sea transport	Trdtrnscomm
50	atp	Air transport	Trdtrnscomm
51	cmn	Communication	Trdtrnscomm
52	ofi	Financial services nec	OthServ
53	isr	Insurance	OthServ
54	obs	Business services nec	OthServ
55	ros	Recreation and other services	OthServ
56	osg	PubAdmin/Defence/Health/Educa t	OthServ
57	dwe	Dwellings	OthServ

Table A2. GTAP country classification and mapping used for analysis

Rest of UK	England, Northern Ireland and Scotland
Wales	Wales
USA	United States of America
China	China
India	India
Rest of EU	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia,
	Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania,
	Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain,
	Sweden, Bulgaria, Belarus, Croatia, Romania
Rest of the World	Rest of the World

Table A3. GDP impact on the local authorities of Wales Ten Years after Brexit

Area	Soft Brexit (EEA membership)	Hard Brexit (WTO Rules)
Cardiff	-1.3	-2.5
Vale of Glamorgan	-1.3	-2.3
Swansea	-1.2	-2.3
Newport	-1.2	-2.1
Gwynedd	-1.1	-2.0
Conwy	-1.0	-1.9
Caerphilly	-1.2	-1.9
Blaenau Gwent	-1.2	-1.9
Ceredigion	-0.9	-1.8
Monmouthshire	-1.0	-1.8
Pembrokeshire	-1.0	-1.8
Wrexham	-1.1	-1.7
Carmarthenshire	-1.0	-1.7
Flintshire	-1.0	-1.7
Powys	-1.0	-1.6
Merthyr Tydfil	-0.8	-1.5
Neath Port Talbot	-1.0	-1.4
Anglesey	-0.6	-1.2

Source: Dhingra, et al, 2017

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